

a 61568



WHO/Mal/249 ✓  
WHO/Insecticides/105  
28 December 1959

ORIGINAL: ENGLISH

STUDIES ON INSECTICIDE-RESISTANT ANOPHELINES  
5. LIPOID CONTENT OF FEMALE ANOPHELES ATROPARVUS

by

I. Neri, K. R. S. Ascher and E. Mosna  
Laboratorio di Parassitologia,  
Istituto Superiore di Sanità, Rome<sup>1</sup>

In a previous note (Neri, Ascher & Mosna, 1958 - Part 3 of this series) a preliminary report on determinations of lipoid content in two resistant and two normal strains of Anopheles atroparvus was presented. In the present study fat assays were extended to all our DDT-resistant strains and a dieldrin-selected strain of A. atroparvus. Since the normal parent strain (Sens.-Roma) of A. atroparvus, from which all the resistant strains had been developed, had yielded inconsistent results in the preliminary work, further repetitions were done with this strain. There was furthermore included in this study a normal and a DDT-resistant strain of A. stephensi.

A short survey of the literature regarding a possible correlation between lipoid content and resistance in mosquitos has been given in Part 3 of this series.

Material and Methods

The susceptible, DDT-resistant and dieldrin-selected strains of A. atroparvus have already been described at length previously (Mosna, Rivosecchi & Ascher, 1958; Mosna, Palmieri, Ascher, Rivosecchi & Neri, 1959). Selection pressure on these strains has been applied steadily since the end of 1955 and fat determinations were carried out on the 32nd selected generation of RAFM and RL (Neri, Ascher & Mosna, 1958) and on the 38th to 42nd generation of the other strains (this report). To improve the breeding activity it was necessary as from the 32nd

---

<sup>1</sup> This investigation was supported by a grant assigned to the Istituto Superiore di Sanità, Rome, by the World Health Organization.

generation to introduce some modifications in the larval food. There was a change of the type of fine wheat bran, and a change from commercial "piscidin" powder to whole dried and ground Daphniae. The ratio of wheat bran to Daphniae powder was also changed and is now 2:1. Thus the results obtained previously (Neri, Ascher & Mosna, 1958) are not directly comparable with the present ones, apart from considering the difference in number of generations selected in the resistant strains.

1. Strains of A. atroparvus (cf. Parts 1 and 2)

Susceptible reference strains

- I. Sens.- Hamburg.
- II. Sens.- Roma.

DDT-resistant strains

- III. RAFM - adult female and male selection.
- IV. RL - larval selection.
- V. RLAF - larval and adult female selection.

Dieldrin-selected strain

- VI. R/Dieldrin - larval selection with dieldrin

2. Strains of A. stephensi

- VII. Sens.- A. stephensi - originating from a colony maintained at the Ross Institute, London.
- VIII. DDT-res.- A. stephensi - derived from strain VII by selection, in each generation since the end of 1955, of the adult females by exposure to DDT by the Busvine & Nash method.

Determination of lipid content was done on samples consisting of 2000 females. Soxhlet extractions from samples of each strain were carried out as described previously by:

- (a) acetone extraction, and
- (b) ether extraction followed by re-extraction of the residue with acetone.

Full details of the extraction procedures were quoted previously (Neri, Ascher & Mosna, 1958).

## Results

The results of the preliminary study (Neri, Ascher & Mosna, 1958) are summarized briefly in Table 1. According to this table the strain Sens.-Hamburg has the lowest fat content, followed by Sens.-Roma, with a discrepancy, however, between the two results. The DDT-resistant strains RL and especially RAFM have a higher lipid content.

Tables 2 and 3 show the results of further assays on the other resistant strains of A. atroparvus and several replicates of Sens.-Roma. Again, the DDT-resistant strain RLAF has a much higher lipid content than Sens.-Roma. The strain R/dieldrin (larval selection only, of about three times resistance to dieldrin in both adult and larval stages; adult resistance to DDT about twice) has practically the same lipid content as the normal strain.

Also a DDT-resistant strain of A. stephensi tends to have a higher percentage of lipoids than its normal parent strain. It was noted that in general the lipid level of A. stephensi was higher than that of A. atroparvus raised under the same conditions.



TABLE 1. FAT DETERMINATIONS, A. ATROPARVUS (2nd GENERATION)  
 (AFTER NEELASCHER AND MOSNA, 1958 - PART 3)

No.	Strain	Mode of extraction	Percentage of fat extracted, calculated on fresh weight			Percentage of total fat extracted, calculated on fresh weight
			a	b	b'	
I	Sens.-Hamburg "	a	4.50%	Susceptible strains		4.50%
		b + b'		3.39%	0.91%	4.30%
II	Sens.-Roma "	a	6.016%			6.016%
		b + b'		3.994%	0.974%	4.986%
III	RAFPM "	a	6.752%	Resistant strains		6.752%
		b + b'		6.026%	0.760%	6.786%
IV	RL "	a	6.30%			6.30%
		b + b'		4.85%	1.31%	6.16%

TABLE 2. FAT DETERMINATIONS, A. ATROPARVUS (40th TO 42nd GENERATION)

No.	Strain	Mode of extraction	Fresh weight of 2000 ♀♀, grams	Weight of fat extracted, grams			Percentage of fat extracted, calculated on fresh weight			Percentage of total fat extracted, calculated on fresh weight	Busvine & Nash $LC_{50}$ (**), done in same Generation as fat determination	
				a	b	b'	a	b	b'		DDP	Dieldrin
II	Sens.-Roma " " " "	a	5.2933	0.2146			4.054%		$\frac{4.054\%}{3.373\%}$	1 hour's contact		
		a	5.0396	0.1698		3.373%		$\frac{3.373\%}{3.351\%}$	3.3 (900)		0.18 (1200)	
V	RLAF " " " "	a	5.7742	0.3248			5.625%		$\frac{5.625\%}{5.970\%}$	1 hour's contact		
		a	5.2762	0.3150		5.970%		$\frac{5.970\%}{5.830\%}$	> 4.0 (2500)			
VI	R/dieldrin " " " "	b ++	6.2418	0.3584			5.742%		$\frac{5.742\%}{0.088\%}$			
		a	3.0997 (*)	0.1380		4.452%		$\frac{4.452\%}{5.022\%}$			0.42 (900)	
		b + b'	3.3354 (*)	0.1675		5.022%		$\frac{5.022\%}{4.374\%}$				
		b + b'	4.5739	0.1741		0.0260	3.806%		$\frac{3.806\%}{0.568\%}$			

TABLE 3. FAT DETERMINATIONS, A. STEPHENSI (38th TO 39th GENERATION)

VII	Sens.- <u>A. stephensi</u> " " " "	a	4.2807	0.2474			5.779%		$\frac{5.779\%}{6.912\%}$	1.9 (1500)	
		b + b'	4.2813	0.2814		0.0145	6.573%		$\frac{6.573\%}{0.339\%}$		
VIII	DDD-res. <u>A. stephensi</u> " "	a	4.1790	0.3261			7.803%		$\frac{7.803\%}{8.402\%}$		
		b + b'	4.4118	0.3657		0.0050	8.289%		$\frac{8.289\%}{0.113\%}$	3.9 (1800)	

(\*) Raised at high larval density.

(\*\*) The figure in parenthesis is the number of females employed in determining the  $LC_{50}$ .

### Discussion

It appears from this and the previous study on this subject that the DDT-resistant strains of A. atroparvus developed in this laboratory tend to have a higher lipid content than the normal parent strain or a normal reference strain (Sens.-Hamb.). This does not hold true for a strain selected in the larval stage with dieldrin for the same number of generations which had about the same low lipid content as the normal parent strain. This might be due to the low resistance level of the strain R/dieldrin. But it is also quite possible that DDT-resistance is correlated with other biological factors than resistance to dieldrin or lindane. Some evidence of this was given by McKenzie & Hoskins (1954) working with the house-fly. This might explain the reason of absence of higher fat content in a dieldrin-selected strain found by us, and also in a strain of A. gambiae resistant to dieldrin and lindane reported by Bradbury, Campbell & O'Carroll (1958).

### Summary

Continuing the previous work, further fat determinations were carried out on DDT-resistant and dieldrin-selected strains of A. atroparvus and a DDT-resistant strain of A. stephensi, which were compared with normal reference strains. The DDT-resistant strains developed in our laboratory tend to have a higher fat content than the normal parent strains. This did not hold true for a dieldrin-selected strain of A. atroparvus.

### Acknowledgement

K. R. S. Ascher is indebted to the World Health Organization for a research scholarship and to the Istituto Superiore di Sanità for the hospitality accorded.

REFERENCES

Bradbury, F. R., Campbell, A. & O'Carroll, F. M. (1958) Indian J. Malar. 12, 547

McKenzie, R. E. & Hoskins, W. M. (1954) J. econ. Ent. 47, 948

(Previous publications in this series)

Mosna, E., Rivosecchi, L. & Ascher, K. R. S. (1958) Studies on insecticide-resistant anophelines. 1. Chromosome arrangements in a dieldrin-selected strain of Anopheles atroparvus. Bull. Wld Hlth Org. 19, 297

Mosna, E., Palmieri, C., Ascher, K. R. S., Rivosecchi, L. & Neri, I. (1959) Studies on insecticide-resistant anophelines. 2. Chromosome arrangements in laboratory-developed DDT-resistant strains of Anopheles atroparvus. Bull. Wld Hlth Org. 20, 63

Neri, I., Ascher, K. R. S. & Mosna, E. (1958) Studies on insecticide-resistant anophelines. 3. Preliminary report on lipid content in some strains of A. atroparvus. Indian J. Malar., 12, 565

Frontali, N. & Carta, S. (1959) Studi sulla resistenza degli Anofeli agli insetticidi. 4. Declorurazione del DDT in ceppi sensibili e resistenti di A. atroparvus. Riv. Parassit. 20, 107